# ASTR 202 – Exploration of the Solar System

## Spring 2018


**Instructor:** **Prof. Stephen Bradshaw (302 Herman Brown Hall, ext. 4045)**
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**Class Website:** **Canvas: ASTR 202 Sp18**
**Lectures:** **Tuesday and Thursday, 9:25am – 10:40am, KWG 100**
**Office Hours:** **After each class and by email appointment**
**Teaching Assistant:** **Elena Busch (elena.l.busch@rice.edu)**
**TA Session:** **Sundays, 6 - 8pm, Baker College Commons**

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## 1. Course Description

This course is intended to provide an introduction to the fundamentals of modern astronomy and our current understanding of the solar system. The course is designed to satisfy Group III distribution requirements.

Exploration of the Solar System starts with an overview of the universe and our place within it, before embarking upon a tour of the solar system to learn about its major features and how it came to be. Along the way we will learn about some of the history of astronomy and the interesting characters who led its development. We will also study many of the fundamentals of astronomy such as the motion of celestial bodies, why understanding these motions matters to us on Earth, and how we came to know much of what we know about the skies thanks to the invention of the telescope.

In the second part of the course we will investigate the geological features and atmospheric conditions of Earth and the other terrestrial worlds, and the properties of the Jovian (or giant) planets. Along the way we will encounter asteroids, meteorites and comets, before leaving the solar system altogether to discover new worlds orbiting distant stars.

During the course we will review and emphasize basic physics such as forces and motion, conservation laws, energy and temperature, and the interaction between light and matter, all of which are needed to understand the fascinating objects that we see in our skies.

## 2. Learning Outcomes

The student learning outcomes of this course encompass a variety of knowledge and skills that apply scientific reasoning to an understanding of the solar system, the bodies of which it is comprised, and the means by which we gather and interpret the information that lead to this understanding. In particular, the students will be able to:

- Demonstrate and understanding of the basic principles of science and scientific investigation;
- Show how observations can inform our understanding of astronomical phenomena;
- Apply an understanding of everyday physical behavior to the planets in the solar system;
- Explain how electromagnetic radiation is used by astronomers to gain information about the properties of astronomical bodies;
- Discuss how gravity governs the motion of the planets in the sky;
- Relate the basic properties of matter to an understanding of astronomical observations;
- Discuss the basic processes at work in planetary atmospheres and planetary geology;
- Discuss the nature of our solar system in the context of newly discovered exoplanet systems;
- Apply scientific reasoning to everyday situations.

## 3. Prerequisites

No scientific or mathematical background beyond high school physics and algebra is assumed. The homework problem sets will not require calculus, but some will involve equations and making calculations. Remember that they are designed to reinforce what you learn, not to catch you out. Examples relevant to the homework problem sets will be worked through during class.

## 4. Course Textbook

The text for this course is:

Title: The Cosmic Perspective: The Solar System ($8^{th}$ edition)
Author: Bennett, Donahue, Schneider and Voit
ISBN-13: 978-0134073811
ISBN-10: 0134073819
Edition: 8th

If you are also planning to take ASTR 201 in another semester then you may instead purchase the following text:

Title: The Cosmic Perspective (8th edition)
Author: Bennett, Donahue, Schneider and Voit
ISBN-13: 978-0134059068
ISBN-10: 0134059069
Edition: 8th

The first book contains only the material that we will cover in ASTR 201. The second book contains all of the material for ASTR 201 and ASTR 202. Both books come with access to the website MasteringAstronomy, which provides a large amount of supplementary material that you may find useful as an aid to understanding if you struggle with any of the concepts. If you have a used copy of either textbook then you can purchase access to the website separately at: www.masteringastronomy.com. There are plenty of free alternatives online too. The PhET interactive simulations (phet.colorado.edu) are a good place to start. Simulations more specific to astronomy can be found at: astro.unl.edu/animationsLinks.html.

**Note that the 7th edition of both textbooks is also available. The 7th edition is suitable for this course and significantly less expensive.**

## 5. Class Website

All course materials including problem sets, links to relevant websites, supplementary material, and class updates and announcements will be posted on the ASTR 202 Canvas page. It is the responsibility of the student to check Canvas regularly for the most recent information concerning the class.

## 6. Special Needs

If you have a documented disability that requires special consideration for this class then please contact the professor as soon as possible to discuss your needs. Students with disabilities should also contact the Disability Support Services Office (dss.rice.edu).

## 7. Assessment

**The Honor Code applies to all assessment tasks.** You can review Rice's Honor Council documentation online at: honor.rice.edu/index.cfm

Homework problem sets: There will be weekly problem sets with questions from the course text and other questions at the same level that will be based on the material covered during the previous week. A problem set will be posted on Canvas each Tuesday and will be due on Canvas (.docx or .pdf only) before class the following Tuesday. The problem sets will be take-home and open-book. You may (indeed, should) discuss general concepts with your classmates before attempting the questions, but your answers must be the result of your own understanding of the material and you should therefore write up the solutions to each problem set by yourself.

Popular science writing assignment: Features on the solar system often appear in the news and this short project is an opportunity for you to learn more about the science behind the stories. Choose a recent **solar system-related** article that interests you from the popular media and then evaluate it. The first part of your paper should be a more in-depth report of the science upon which your chosen article is based, drawing upon what you have learned from class and other sources. The second part should be a critical review of the article. Questions that you may like to consider are: how much science does the journalist leave out of the article? Is the science that is included reported faithfully or is it misrepresented? Does the article give the non-scientist reader an accurate and honest account of the scientists' work? The paper may contain pictures, diagrams and equations (as long as you can explain them in your own words), and be no more than 1000 words in length. You will be assessed on your understanding of the material (expressing what you have learned in your own words), your ability to connect the material with topics that we have covered in class, the quality of your analysis and discussion, the enthusiasm of your presentation, and your use of

external sources. Marks will be deducted for poor spelling and grammar (e.g. I find "off of" particularly irksome) because the ability to communicate clearly is a critically important skill to develop.

You should keep your eye out for any interesting astronomy-based stories in the news. The Fondren carries the latest popular science journals (e.g. Nature, Science, etc.) and provides access to the online editions. You may, if you wish, check with the professor when you have chosen an article to make sure that it is suitable. This assignment will be due at the beginning of class on **Thursday April 5th 2018**.

Plagiarism will not be tolerated and the professor has no discretion about whether to report it. The procedure for dealing with cases of suspected plagiarism is manifestly unpleasant and stressful (for student and professor), and emphatically not worth the risk to your academic career and to your future. Your work should be clearly distinguishable from its sources and be a direct result of your own understanding of the material. For a guide to what constitutes plagiarism and how to avoid it please consult the Honor Council's document concerning academic fraud: honor.rice.edu/bluebook.cfm?doc_id=10355

## 8. Grades

| Assessment Task | Weighting |
|---|---|
| 14 homework problem sets | 70% |
| Popular science writing assignment | 30% |

The overall grade will be calculated from the grade awarded for each assessment task, with the appropriate weighting applied. Percentage grades are converted into letter grades as follows:

$$A\pm \geq 90\%; \quad 80\% \leq B\pm < 90\%; \quad 70\% \leq C\pm < 80\%; \quad 60\% \leq D\pm < 70\%; \quad F < 60\%$$

You do not need to have a scientific background to get a high grade. However, you will need to work hard and regularly to achieve a top grade. This includes attending class, completing all of the problem sets and talking to the professor as soon as possible when difficulties arise. Misunderstandings can often be cleared up quickly and easily, but if left to fester they will adversely affect your grade and will spoil your enjoyment of the course.

## 9. Attendance and Participation

Students who attend class regularly will be at a significant advantage because material not included in the textbook or class presentations made available on Canvas is often featured during class. Furthermore, the examples that will be worked through during class are directly applicable to the homework problem sets. A sign-in sheet will be passed around about halfway through each class (starting in week 2). Students who attend more than 90% of classes will receive a one-third grade bump in their final grade, such that a B+ becomes an A-, an A- becomes an A, etc. Classes missed for legitimate reasons (illness, athletic commitments, etc.) can be counted for attendance purposes, but will require supporting evidence. Needless to say, students will only sign themselves into each class. Anyone caught signing anyone else in, or being signed in by someone else, will be immediately subject to disciplinary action by the Honor Council and will have all attendance credit cancelled for the entire semester. Finally, you are expected to participate in class activities and to ask questions.

## 10. Cellphones and Laptop Computers, etc.

**Cellphones must be switched off upon entering the classroom.**

Laptop computers, netbooks, iPads, etc., may be used for the purpose of note taking only. Other activities are likely to be extremely distracting for others sitting nearby. If non-course-based electronic-device use becomes a problem during the semester then an in-class ban will be implemented.

## 11. TA Sessions

The course TA will run a two-hour TA session each week during which you are welcome to ask questions about the course material, homework questions, and so forth. Note that you are also encouraged to make use of the professor's office hours too. This semester the TA session will be on **Sundays, 6 - 8pm, in the Baker College Commons**.

## 12. Observing Sessions

The Rice University Campus Observatory (RUCO: http://www.ruf.rice.edu/~ruco/observatory.html) provides an excellent opportunity for hands-on stargazing. Nighttime observing sessions will be scheduled during the semester. However, as with most Earth-based astronomical endeavors, we are at the mercy of the weather and the local 'seeing' conditions. This means that observing sessions may be organized and cancelled at unavoidably short notice. The best nights for practical astronomy are clear and cold, so you are advised to dress warmly.

## 13. Class Schedule (tentative)

**January**

| | | | |
|---|---|---|---|
| (1) Tuesday | 9th | - | Part I: Ch. 1. A Modern View of the Universe |
| (2) Thursday | 11th | - | Part I: Ch. 1. A Modern View of the Universe |
| (3) Tuesday | 16th | - | Part I: Ch. 2. Discovering the Universe |
| (4) Thursday | 18th | - | Part I: Ch. 2. Discovering the Universe |
| (5) Tuesday | 23rd | - | Part I: Ch. 3. The Science of Astronomy |
| (6) Thursday | 25th | - | Part I: Ch. 3. The Science of Astronomy |
| (7) Tuesday | 30th | - | Part II: Ch. 4. Making Sense of the Universe |

**February**

| | | | |
|---|---|---|---|
| (8) Thursday | 1st | - | Part II: Ch. 4. Making Sense of the Universe |
| (9) Tuesday | 6th | - | Part II: Ch. 5. Light and Matter |
| **Thursday** | **8th** | **-** | **SPRING RECESS** |
| (10) Tuesday | 13th | - | Part II: Ch. 5. Light and Matter |
| (11) Thursday | 15th | - | Part II: Ch. 5. Light and Matter |
| (12) Tuesday | 20th | - | Part II: Ch. 5. Light and Matter & Part II: Ch. 6. Telescopes |
| (13) Thursday | 22nd | - | Part II: Ch. 6. Telescopes |
| (14) Tuesday | 27th | - | Part II: Ch. 6. Telescopes & Part V: Ch. 14. The Sun |

**March**

| | | | |
|---|---|---|---|
| (15) Thursday | 1st | - | Part V: Ch. 14. The Sun |
| (16) Tuesday | 6th | - | Part V: Ch. 14. The Sun & Part III: Ch. 7. Our Planetary System |
| (17) Thursday | 8th | - | Part III: Ch. 7. Our Planetary System |
| **Tuesday** | **13th** | **-** | **SPRING BREAK** |
| **Thursday** | **15th** | **-** | **SPRING BREAK** |
| (18) Tuesday | 20th | - | Part III: Ch. 7. Our Planetary System & |

| | | | |
|---|---|---|---|
| | | | Part III: Ch. 8. Formation of the Solar System |
| (19) Thursday | 22nd | - | Part III: Ch. 8. Formation of the Solar System |
| (20) Tuesday | 27th | - | Part III: Ch. 8. Formation of the Solar System & Part III: Ch. 9. Planetary Geology |
| (21) Thursday | 29th | - | Part III: Ch. 9. Planetary Geology |

**April**

| | | | |
|---|---|---|---|
| (22) Tuesday | 3rd | - | Part III: Ch. 9. Planetary Geology & Part III: Ch. 10. Planetary Atmospheres |
| (23) Thursday | 5th | - | Part III: Ch. 10. Planetary Atmospheres |
| (24) Tuesday | 10th | - | Part III: Ch. 10. Planetary Atmospheres & Part III: Ch. 11. Jovian Planet Systems |
| (25) Thursday | 12th | - | Part III: Ch. 11. Jovian Planet Systems |
| (26) Tuesday | 17th | - | Part III: Ch. 11. Jovian Planet Systems & Part III: Ch. 12. Asteroids, Comets & Dwarf Planets |
| (27) Thursday | 19th | - | Part III: Ch. 12. Asteroids, Comets & Dwarf Planets |

## 14. Problem Set and Written Assignment Deadlines

Deadlines are strictly enforced. Requests for extensions must be granted by the professor (by email, so that a written record exists) BEFORE the due date of the assignment. You will need a valid reason accompanied by supporting documentation.

**January**

| | | | |
|---|---|---|---|
| (3) Tuesday | 16th | - | Problem Set 1 (C1-2) released. |
| (5) Tuesday | 23rd | - | Problem Set 1 (C1-2) due. Problem Set 2 (C3-4) released. |
| (7) Tuesday | 30th | - | Problem Set 2 (C3-4) due. Problem Set 3 (C5-6) released. |

**February**

| | | | |
|---|---|---|---|
| (9) Tuesday | 6th | - | Problem Set 3 (C5-6) due. Problem Set 4 (C7-8) released. |
| (10) Tuesday | 13th | - | Problem Set 4 (C7-8) due. Problem Set 5 (C9) released. |
| (12) Tuesday | 20th | - | Problem Set 5 (C9) due. Problem Set 6 (C10-11) released. |
| (14) Tuesday | 27th | - | Problem Set 6 (C10-11) due. Problem Set 7 (C12-13) released. |

**March**

| | | | |
|---|---|---|---|
| (16) Tuesday | 6th | - | Problem Set 7 (C12-13) due. Problem Set 8 (C14-15) released. |
| Tuesday | 13th | - | Problem Set 9 (C16-17) released. |
| (18) Tuesday | 20th | - | Problem Set 8 (C14-15) due. |
| (20) Tuesday | 27th | - | Problem Set 9 (C16-17) due. Problem Set 10 (C18-19) released. |

**April**

| | | | |
|---|---|---|---|
| (22) Tuesday | 3rd | - | Problem Set 10 (C18-19) due. Problem Set 11 (C20-21) released. |
| (23) Thursday | 5th | - | Written assignment due. |
| (24) Tuesday | 10th | - | Problem Set 11 (C20-21) due. Problem Set 12 (C22-23) released. |
| (26) Tuesday | 17th | - | Problem Set 12 (C22-23) due. Problem Set 13 (C24-25) released. |
| (27) Thursday | 19th | - | Problem Set 14 (C26-27) released. |

**May**

Wednesday 2nd - Problem Sets 13 (C24-25) and 14 (C26-27) due no later than 5pm.

Notes: (CX-Y) indicates that the questions will be based only on the material covered in classes X to Y.